

Harlan County Lake 2000 Water Quality Report

1. General.

a. **Project location.** Harlan County Dam is located at river mile 232.3 of the Republican River about 8 miles east of Alma, Nebraska. The watershed encompasses 7,169 square miles in south-central Nebraska.

b. **Authorized project purposes.** Flood control, irrigation, and water quality are the primary project purposes; equally important, however, are its fish and wildlife resources and recreation benefits.

c. Pertinent data.

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1,000 A.F.)	Surface Area (acres)	Shoreline (miles)
Flood	1,973.5	496.7	22,820	
Multipurpose	1,946.0	315.1*	13,262	75
Inactive		159.1**		
Total		811.8		

Total Drainage Area: 7,169 sq. miles

Average Annual Inflow: 258,658 acre-feet

* Estimated based on most recent hydrographic survey

** Contained in multipurpose pool.

2. Activities and studies of the year.

Monthly herbicide and nutrient sampling was conducted by lake project personnel, with technical and analytical support from PM-PR-W, April-September 2000 at one inflow station, three lake stations (two depths), and the outlet. Nutrient samples were shipped to the Chemical and Materials Quality Assurance Laboratory (CMQAL) in Omaha for analysis while the herbicide samples were shipped to the PM-PR-W laboratory for analysis of four of the most commonly occurring herbicides by the enzyme linked immunosorbent assay (ELISA) method. Ten percent of the herbicide samples were shipped to CMQAL to be analyzed by Gas Chromatography (GC) for quality control purposes. All generated data were entered in Excel spreadsheets as an interim to the EPA national water quality data management system, NEW STORET, which is to become readily available to us later this year. Table 1 at the end of this report includes all the available nutrient and herbicide data for the years 1996-2000.

The OF-HC is to be commended for its continued support of water quality monitoring of Harlan County Lake and its tributaries. The OF-HC personnel deserving special recognition include Messrs. Larry Janicek, Jim Brown, Tom Zikmund, and Jim Bowen.

3. Existing conditions.

a. Inflow.

During the six-month sampling period the calculated total nitrogen (TN) concentrations (i.e., $\text{NH}_3 + \text{NO}_2 + \text{NO}_3 + \text{TKN}$) in the inflow waters to Harlan County Lake (station HC-8) continue to exhibit eutrophic conditions with a mean, minimum and maximum of 2.74 mg/L, 1.65 mg/L, and 8.15 mg/L, respectively. Total nitrogen concentrations for the period of record have generally exceeded the Environmental Protection Agency (EPA)

FIGURE 1: HC-8

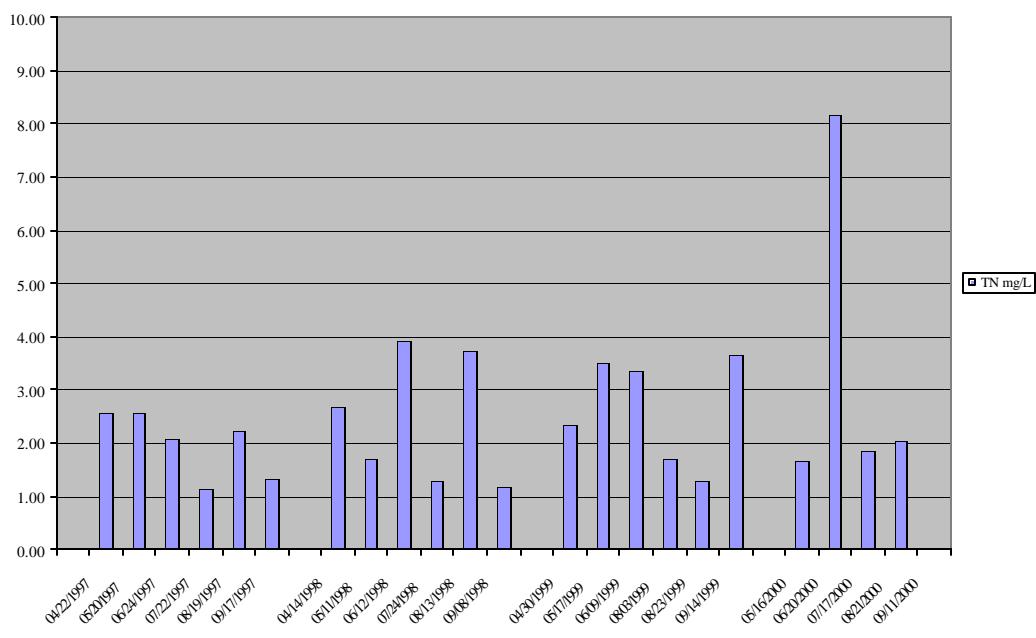
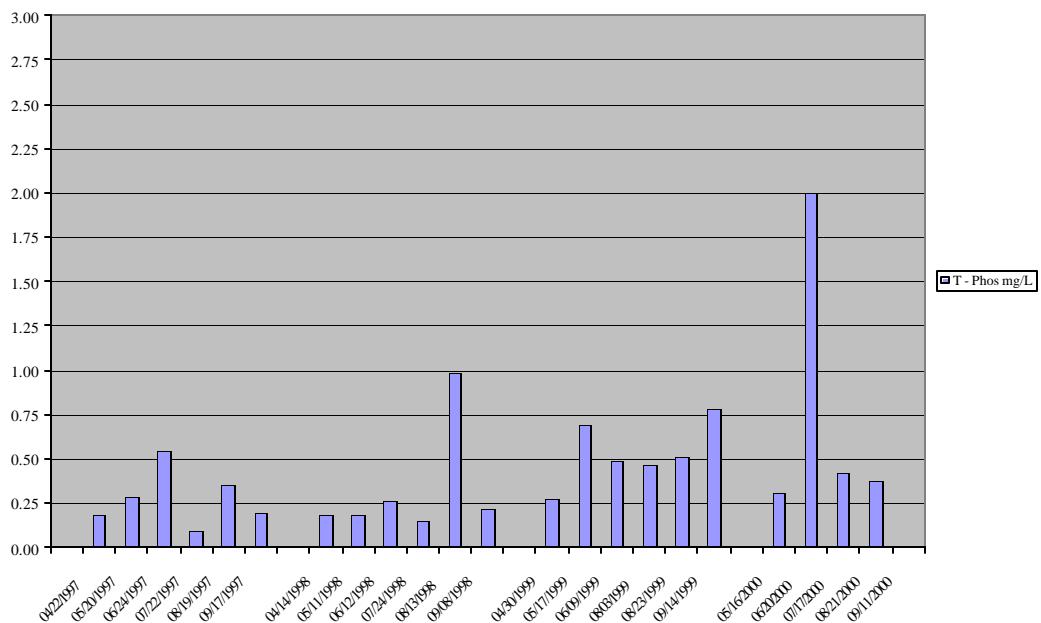


FIGURE 2: HC-8



criterion for the protection of aquatic ecosystems from excessive eutrophication (<1mg/L) and have demonstrated the elevated, long-term, nutrient loading to the stream. Figure 1 shows the trend for total nitrogen concentrations over the past four years. Spikes typically occur during high inflows such as June 2000. The 2000 total phosphorus (TP) concentrations reflected highly enriched conditions (mean, minimum, and maximum concentrations of 0.78 mg/L, 0.31 mg/L, and 2.00 mg/L, respectively). These concentrations were also higher than the EPA suggested stream

criterion of 0.1 mg/L for the protection of aquatic ecosystems. The stream has been characterized by hypereutrophic phosphorus levels over the period of record. Figure 2 shows this trend for the past four years.

The four herbicides (atrazine, metolachlor, alachlor, and cyanazine) were also detected in the inflow waters. A test for acetochlor was also conducted in July but the herbicide was not detected. Atrazine was detected in 100% of the samples with a mean and

FIGURE 3: HC-8

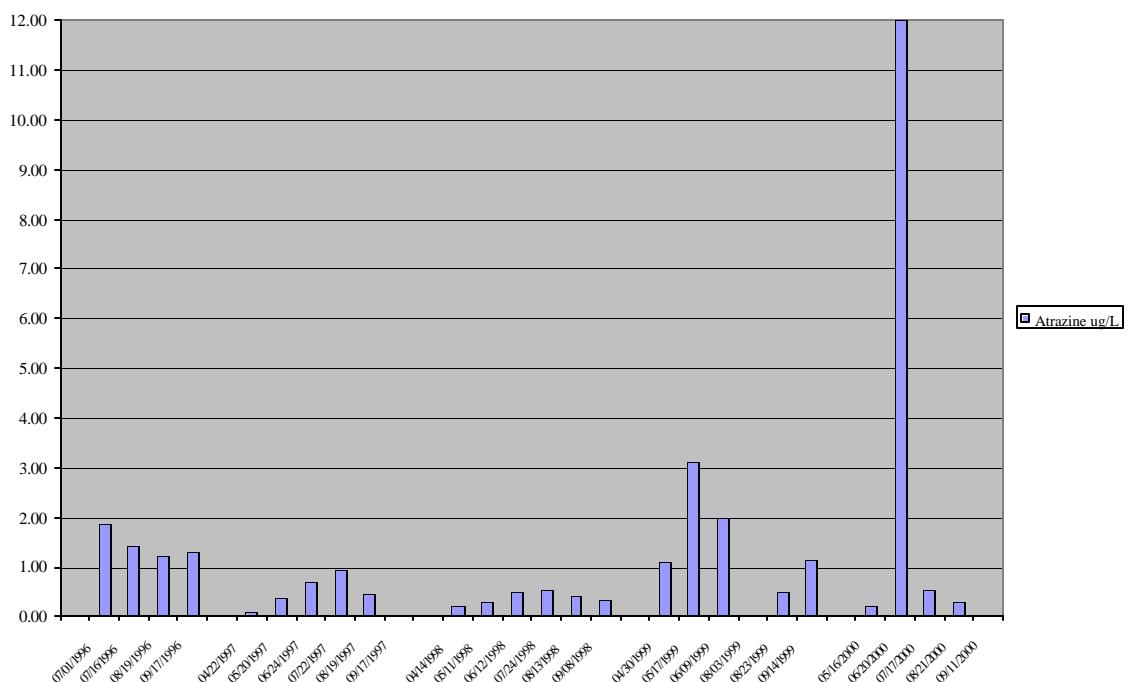
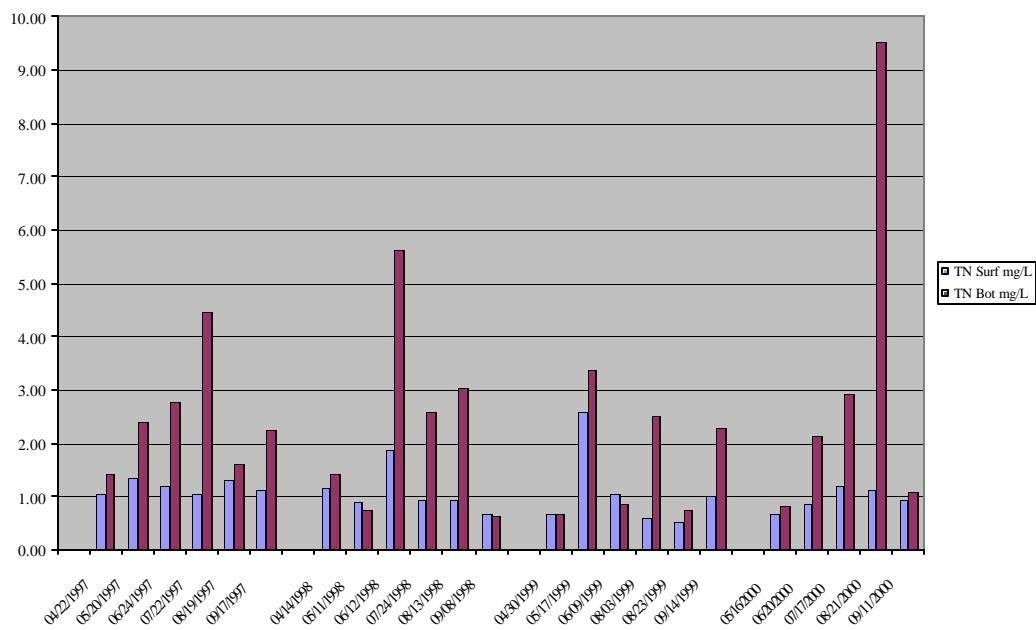


FIGURE 4: HC-2



maximum concentration of 3.27 ug/L and 12.00 ug/L, respectively. One of the samples exceeded the EPA maximum contaminant level (MCL) of 3 ug/L for drinking water. The trend for the past five years is shown in figure 3. Alachlor and cyanazine were detected but quantities of alachlor were so low, there was no danger of exceeding the established criterion of 2 ug/L, however, one sample did exceed the criterion of 1 ug/L for cyanazine. Metolachlor concentrations exceeded 3 ug/L in one of the samples, however, without an established MCL, their significance can not be judged.

b. Lake.
 Stations HC-2 (downlake), HC-4 (midlake), and HC-7 (uplake) were sampled during the six-month sampling period from mid April-September. The 2000 calculated TN concentrations in the lake ranged from moderately enriched in the downlake and midlake sections to highly enriched in the uplake region of the lake. The mean, minimum, and maximum TN concentrations in the surface

FIGURE 5: HC-4

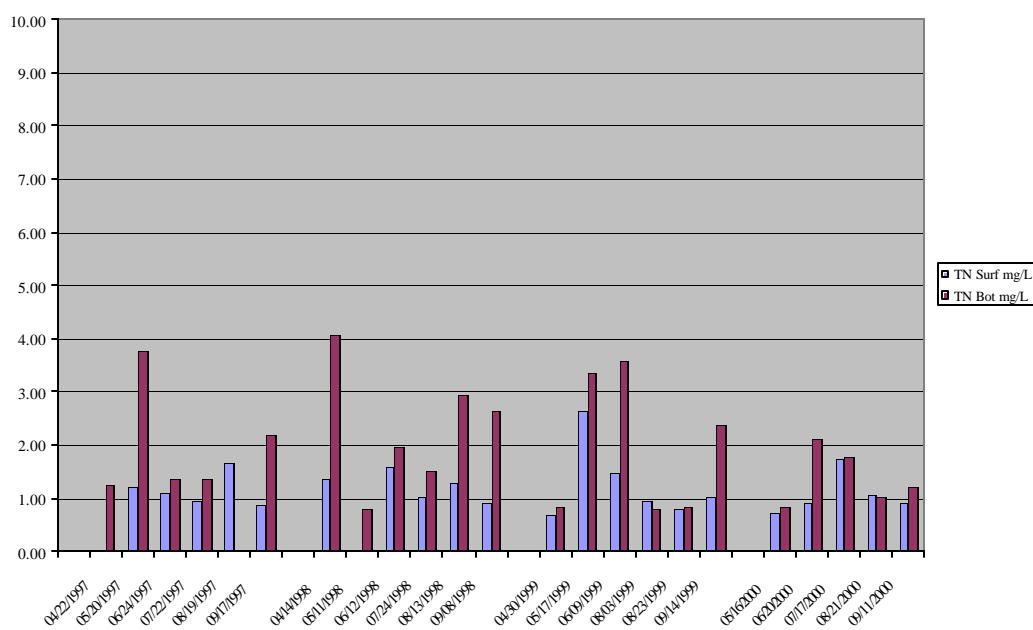
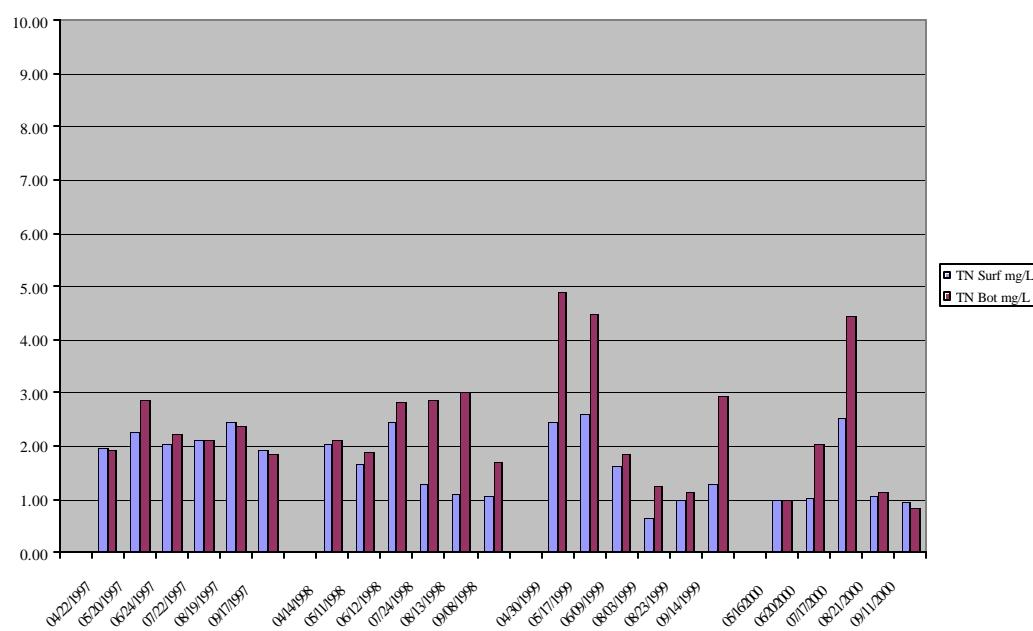


FIGURE 6: HC-7



waters were downlake, 0.96 mg/L, 0.69 mg/L, and 1.20 mg/L; midlake, 1.07 mg/L, 0.74 mg/L, and 1.75 mg/L; and uplake, 1.31 mg/L, 0.93 mg/L, and 2.54 mg/L, respectively. TN concentrations in the bottom waters were more highly enriched with mean, minimum, and maximum concentrations of 3.31 mg/L, 0.83 mg/L, and 9.54 mg/L, respectively, at HC-2, 1.38 mg/L, 0.82 mg/L, and 2.10 mg/L, respectively, at HC-4, and 1.90 mg/L, 0.84 mg/L, and 4.46 mg/L, respectively, at HC-7. Figures 4, 5, and 6 show the relationship between the total nitrogen concentrations of these three lake stations over the past four years. As can be seen from these three graphs, concentrations at bottom depths are equal to or greater than concentrations at the surface. The high spikes can be attributed to high inflows and

temperature differences between surface and bottom waters. Also, the spikes could be attributed to high concentrations of sediment in the samples. Ninety-seven percent of the 2000 total phosphorus concentrations

FIGURE 7: HC-2

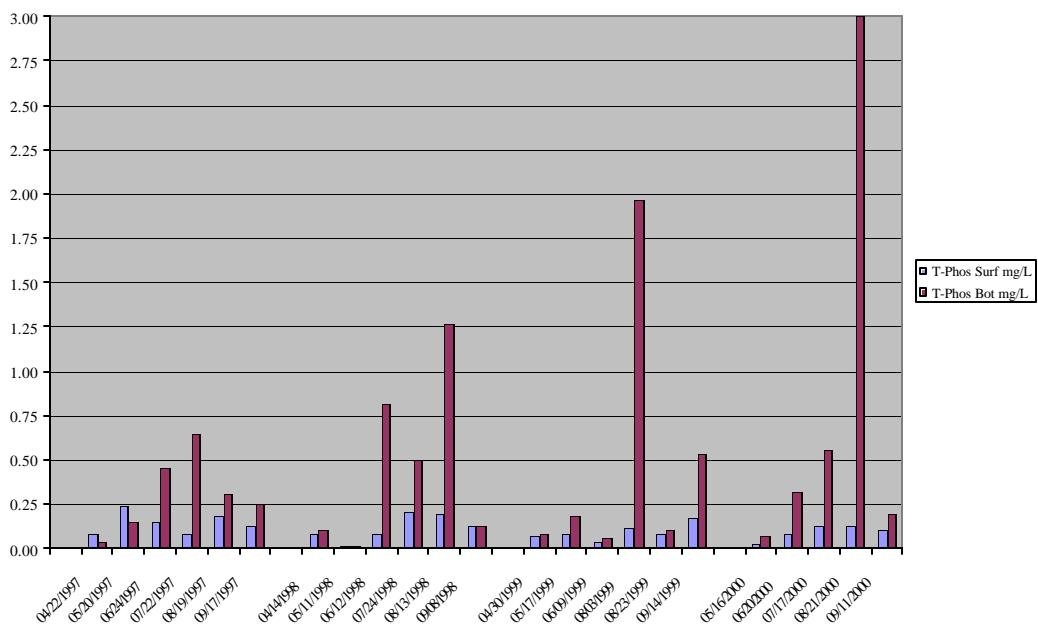
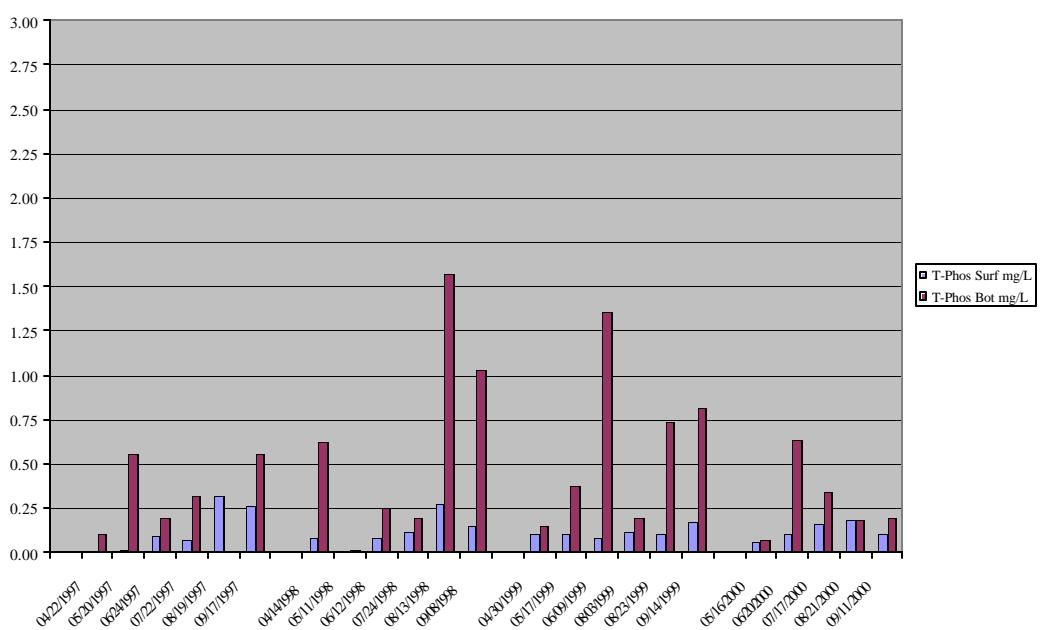


FIGURE 8: HC-4



exceeded the EPA generalized eutrophy criterion for lakes of 0.05 mg/L. The mean TP concentrations in the surface waters of the lake were downlake, 0.09 mg/L; midlake, 0.12 mg/L; and uplake, 0.24 mg/L. Mean TP concentrations were greater in the bottom waters with means of 0.83 mg/L, 0.28 mg/L, and 0.38 mg/L, respectively. The 2000 data continue to show enriched conditions throughout the lake. Figures 7, 8, and 9 show total phosphorus concentrations at the surface and bottom depths throughout the lake 1997-2000.

Total phosphorus concentrations tend to follow the same pattern as the total nitrogen concentrations with spikes appearing during the same sampling periods. Again these can be attributed to high inflows and temperature differences between surface and bottom waters and excess sediment in the samples. The 2000 total phosphorus concentrations followed the long-term trend with 97% of the concentrations equaling or exceeding the EPA generalized

FIGURE 9: HC-7

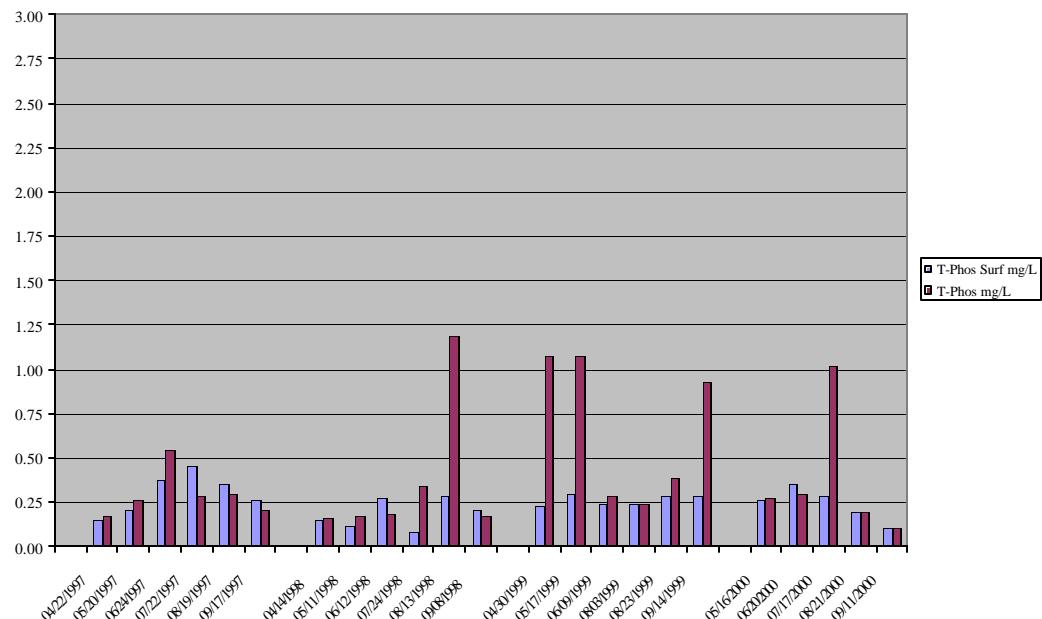
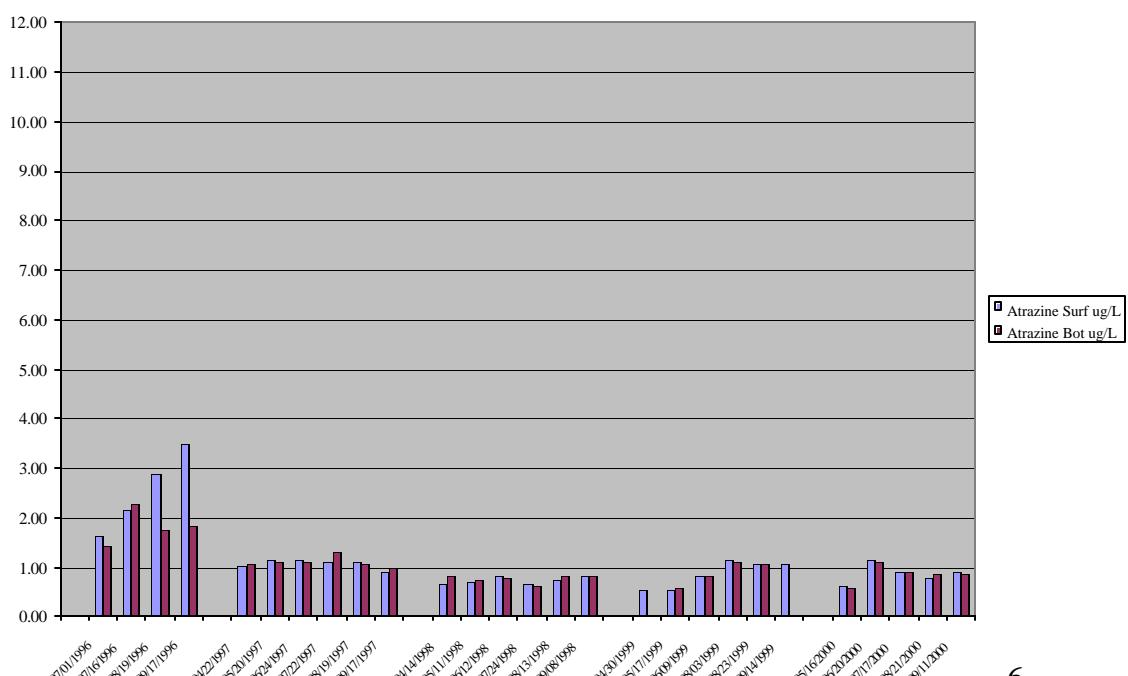


FIGURE 10: HC-2



eutrophy criterion for lakes of 0.05 mg/L.

In the monthly sampling, the four herbicides (atrazine, metolachlor, alachlor, and cyanazine) were detected at all three lake stations. A test was also conducted for acetochlor in July but the herbicide was not detected. Atrazine was detected in 100% of the samples. None of the samples of atrazine exceeded the MCL of 3 ug/L for drinking water but nineteen % of the samples exceeded the 1 ug/L criterion for the protection of aquatic life. The mean and maximum atrazine concentrations in the surface waters of the lake were as follows, 0.88 ug/L and 1.14 ug/L (HC-2); 0.86 ug/L and

FIGURE 11: HC-4

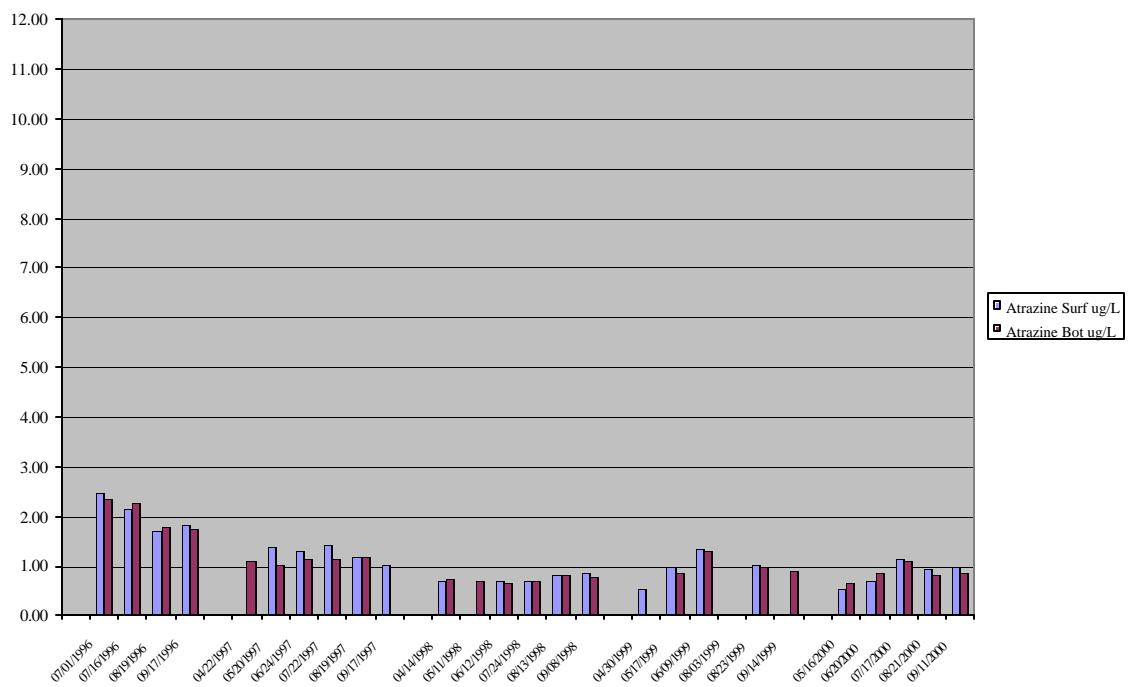
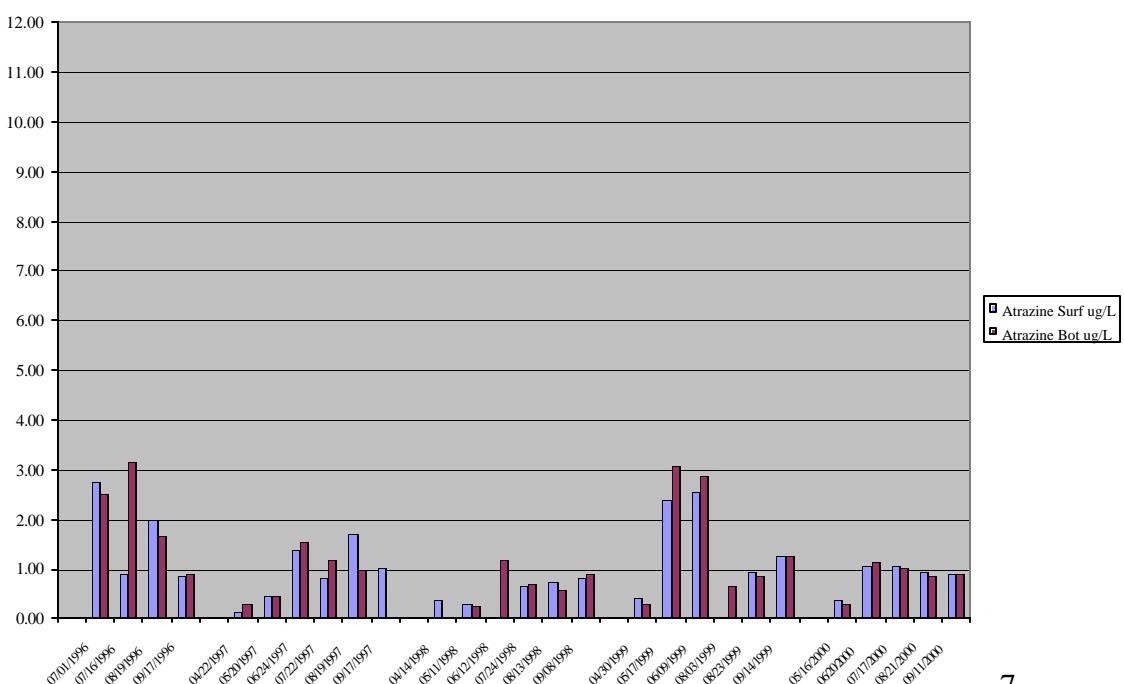


FIGURE 12: HC-7



1.13 ug/L (HC-4); 0.87 ug/L and 1.07 ug/L (HC-7), respectively. Bottom mean and maximum atrazine concentrations for the above areas were as follows, 0.86 ug/L and 1.10 ug/L; 0.86 ug/L and 1.10 ug/L; and 0.85 ug/L and 1.14 ug/L, respectively. Figures 10, 11, and 12 show the trend for atrazine concentrations for the years 1996-2000. As can be seen from these graphs, high concentrations normally occur throughout the lake in early spring during high run-off periods. For the most part, concentrations are uniform throughout the water column. Although alachlor was detected in

11% of the samples and cyanazine was detected in 83% of the 2000 samples, neither exceeded established criteria.

Metolachlor also was frequently detected (78% of the samples) in very low concentrations.

c. Outflow.

The nutrient levels remained moderately to highly enriched with mean total nitrogen and total phosphorus concentrations of 0.82 mg/L and 0.21 mg/L, respectively.

Again, as shown in figures 13 and 14, concentrations are higher during the high run-off periods. Of the four pesticides atrazine and

FIGURE 13: HC-1

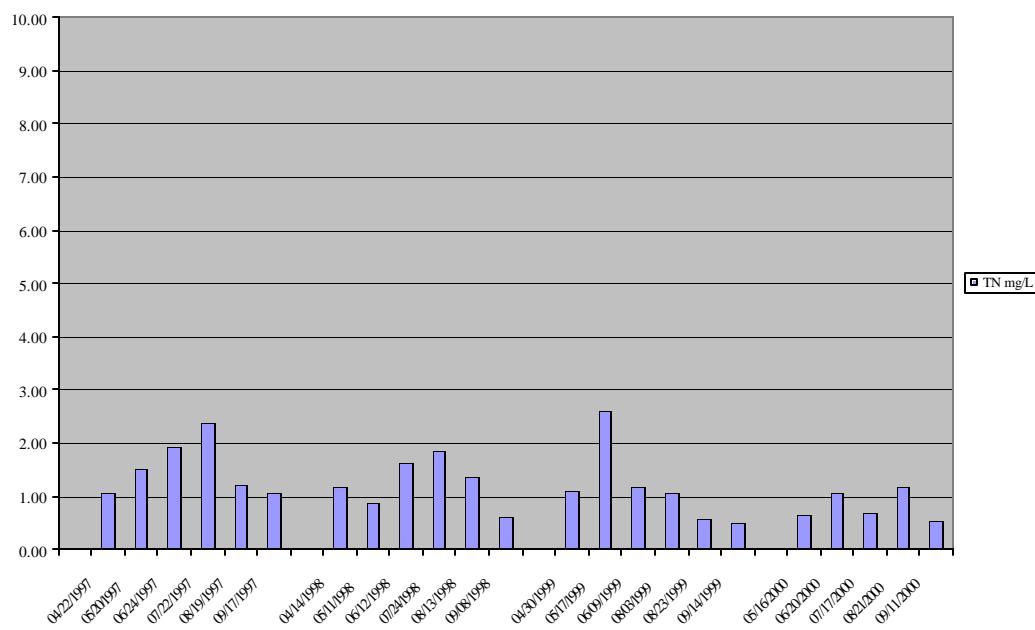
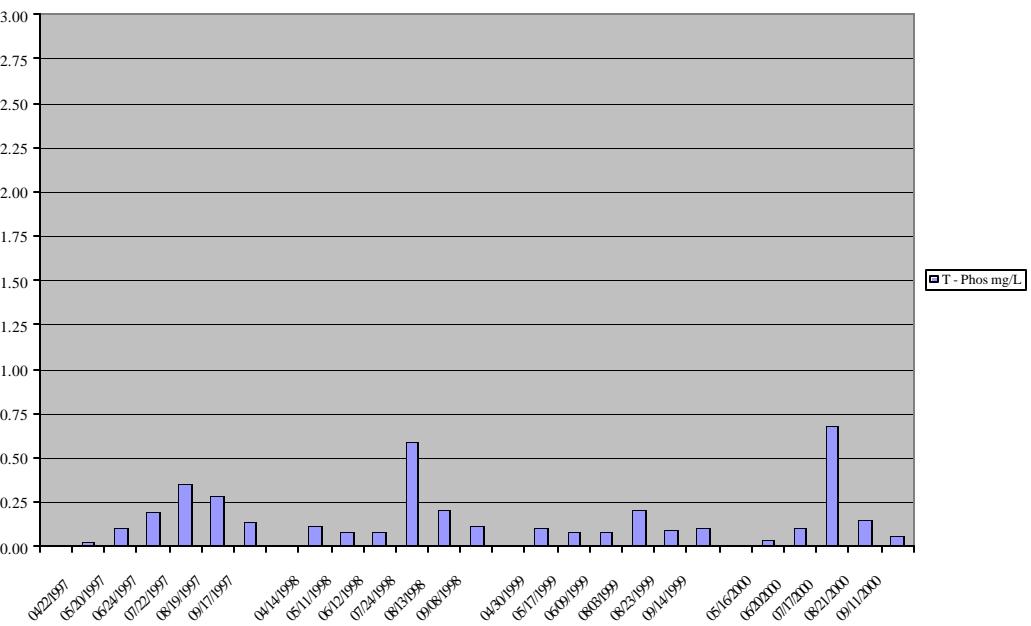
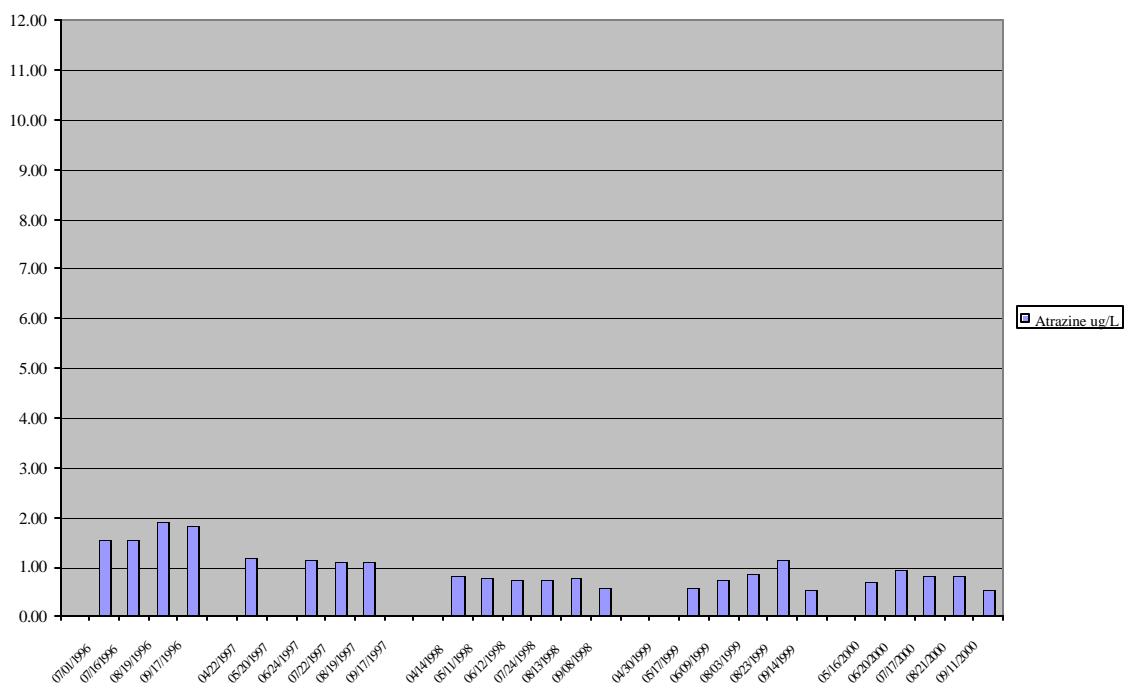


FIGURE 14: HC-1



cyanazine were detected in 100% of the samples. None of the four herbicides exceeded any established criteria, however, atrazine had the greatest concentrations. The mean and maximum atrazine concentrations in the released waters were 0.77 ug/L and 0.96 ug/L, respectively. Figure 15 shows the trend for the years 1996-2000. As can be seen from this graph, concentrations of atrazine in the outlet have been fairly consistent for the past four years.

FIGURE 15: HC-1



4. Future conditions .

The water quality concerns of Harlan County Lake continue to center around heavy suspended solids, nutrient, and pesticide loading in the old impoundment. The tremendous sediment load entering the reservoir during storm events will continue to be the major impairment to water quality until soil conservation practices and crop- and livestock-production strategies are altered. The increased turbidity, suspended solids, nutrients, and pesticides from point and non-point sources will ultimately reduce the reservoir's water quality and project benefits.

5. Recommendations .

With the current staffing and funding levels, the water quality surveillance program for Harlan County Lake will continue to be limited to monthly surveillance of herbicides nutrients by the Project personnel with logistical and analytical support from PM-PR-W in 2001. Although there is little current support for its implementation, the District should continue to promote an expanded, cooperative, water quality monitoring and abatement program for Harlan County Lake and its watershed similar to the one currently underway for Hillsdale Lake and the Big Bull watershed.

TABLE 1: HARLAN COUNTY LAKE DATA 1996-2000

Station	Depth M	Date mm/dd/yy	Time hh/mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC - 8	0.1	07/01/1996	1110	1.88	0.09	0.79	0.10							
	0.1	07/16/1996	1107	1.42	0.32	0.38	0.14							
	0.1	08/19/1996	0940	1.20	<0.05	0.16	0.14							
	0.1	09/17/1996	1025	1.31	<0.05	<0.05	0.12							
Average				1.45	0.21	0.44	0.13							
HC - 8	0.1	04/22/1997	1135	0.11	0.06	<0.05	0.09		0.05	1.41	1.10	2.56	0.18	0.16
	0.1	05/20/1997	1120	0.36	<0.05	0.12	<0.04		0.26	1.20	1.10	2.56	0.28	0.23
	0.1	06/24/1997	1135	0.71	0.39	<0.05	0.42		<0.02	0.29	1.80	2.09	0.54	0.23
	0.1	07/22/1997	1110	0.94	0.29	0.35	0.22		0.12	0.02	1.00	1.14	0.09	0.04
	0.1	08/19/1997	0925	0.45	0.06	0.07	0.04		0.03	0.49	1.70	2.22	0.35	0.08
	0.1	09/17/1997	1130						<0.02	0.41	0.90	1.31	0.20	0.12
Average				0.51	0.20	0.18	0.19		0.12	0.64	1.27	1.98	0.27	0.14
HC - 8	0.1	04/14/1998	1030	0.20	<0.05	0.05	<0.04		0.04	1.42	1.20	2.66	0.18	0.13
	0.1	05/11/1998	0853	0.30	0.08	0.59	0.07		0.03	0.97	0.70	1.70	0.18	0.10
	0.1	06/12/1998	1148	0.49	.050K	0.08	0.05		1.15	1.17	1.60	3.92	0.26	0.18
	0.1	07/24/1998	1330	0.52	0.06	0.21	0.14		0.03	0.06	1.20	1.29	0.15	0.09
	0.1	08/13/1998	1700	0.43	<0.05	0.05	<0.04		0.85	0.28	2.60	3.73	0.98	0.20
	0.1	09/08/1998	0940	0.34	<0.05	<0.05	0.08		<0.02	0.19	1.00	1.19	0.22	0.07
Average				0.38	0.07	0.20	0.09		0.42	0.68	1.38	2.42	0.33	0.13
HC - 8	0.1	04/30/1999	1130	1.11	<0.05	0.54	0.11		U	1.50	0.84	2.34	0.27	0.19
	0.1	05/17/1999	1130	3.12	0.11	0.91	0.15		0.33	0.85	2.34	3.52	0.69	0.20
	0.1	06/09/1999	1700	1.99	<0.05	0.65	0.17		0.42	1.17	1.75	3.34	0.49	0.17
	0.1	08/03/1999	1350						0.05	1.16	0.48	1.69	0.47	0.33
	0.1	08/23/1999	1015	0.49	0.05	0.24	0.07		0.07	0.88	0.35	1.30	0.51	0.30
	0.1	09/14/1999	1045	1.14	<0.05	<0.05	0.08		U	1.50	2.17	3.67	0.78	0.36
Average				1.57	0.08	0.59	0.12		0.22	1.18	1.32	2.64	0.54	0.26
HC-8	0.1	05/16/2000	1045	0.22	0.10	0.13	<0.04		U	0.65	1.00	1.65	0.31	0.12
	0.1	06/20/2000	1045	12.00	0.06	3.49	1.74		0.43	2.72	5.00	8.15	2.00	0.66
	0.1	07/17/2000	1120	0.54	<0.05	0.19	0.07	<0.04	0.60	U	1.26	1.86	0.42	0.10
	0.1	08/21/2000	1030	0.30	<0.05	0.11	0.04		0.04	U	2.00	2.04	0.37	0.02
	0.1	09/11/2000										0.00		
Average				3.27	0.08	0.98	0.62		0.36	1.69	2.32	2.74	0.78	0.23
HC - 1	0.1	07/01/1996	1140	1.54	0.10	0.40	0.26							
	0.1	07/16/1996	1037	1.53	0.07	0.23	0.27							
	0.1	08/19/1996	1030	1.90	0.15	0.61	0.39							
	0.1	09/17/1996	1120	1.84	0.19	0.56	0.37							
Average				1.70	0.13	0.45	0.32							

Station	Depth M	Date mm/dd/yy	Time hh:mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC - 1	0.1	04/22/1997	1200	1.18	<0.05	0.16	0.32		0.04	0.14	0.90	1.08	0.03	0.02
	0.1	05/20/1997	1130						0.41	0.12	1.00	1.53	0.11	0.05
	0.1	06/24/1997	1200	1.14	0.21	0.08	<0.04		0.54	0.17	1.20	1.91	0.19	0.16
	0.1	07/22/1997	1145	1.10	0.15	0.22	0.26		0.84	0.05	1.50	2.39	0.35	0.22
	0.1	08/19/1997	0925	1.10	0.09	0.16	0.21		0.05	0.18	1.00	1.23	0.29	0.06
	0.1	09/17/1997	1205						0.15	0.12	0.80	1.07	0.14	0.05
Average				1.13	0.15	0.16	0.26		0.34	0.13	1.07	1.54	0.19	0.09
HC - 1	0.1	04/14/1998	0955	0.83	<0.05	0.06	0.14		0.05	0.01	1.10	1.16	0.12	0.02
	0.1	05/11/1998	1048	0.78	0.09	0.09	0.13		0.14	0.03	0.70	0.87	0.08	0.03
	0.1	06/12/1998	1145	0.72	<0.05	0.07	0.13		0.17	0.36	1.10	1.63	0.08	0.06
	0.1	07/24/1998	1130	0.74	0.08	0.08	0.12		0.50	0.16	1.20	1.86	0.59	0.30
	0.1	08/13/1998	1800	0.79	<0.05	<0.05	0.12		0.55	0.31	0.50	1.36	0.21	0.09
	0.1	09/08/1998	1040	0.58	<0.05	0.07	0.08		0.05	0.17	0.40	0.62	0.12	0.08
Average				0.74	0.09	0.07	0.12		0.24	0.17	0.83	1.25	0.20	0.10
HC - 1	0.1	04/30/1999							U	U	1.10	1.10	0.11	0.04
	0.1	05/17/1999	1100	0.56	<0.05	0.08	0.07		0.08	1.65	0.87	2.60	0.08	0.02
	0.1	06/09/1999	1745	0.75	<0.05	0.09	0.13		0.21	U	0.98	1.19	0.08	0.04
	0.1	08/03/1999	1300	0.86	0.06	0.39	0.21		0.03	0.26	0.77	1.06	0.21	0.18
	0.1	08/23/1999	1050	1.13	0.06	0.34	0.21		0.05	0.24	0.29	0.58	0.09	0.07
	0.1	09/14/1999	1120	0.55	<0.05	0.10	0.07		U	U	0.50	0.50	0.11	0.02
Average				0.77	0.06	0.20	0.14		0.09	0.72	0.75	1.17	0.11	0.06
HC-1	0.1	05/16/2000	1000	0.68	<0.05	0.14	0.14		U	U	0.66	0.66	0.04	U
	0.1	06/20/2000	1000	0.96	<0.05	<0.05	0.05		0.06	U	1.00	1.06	0.10	0.02
	0.1	07/17/2000	1150	0.83	<0.05	0.14	0.14	<0.04	0.48	0.14	0.05	0.67	0.68	0.07
	0.1	08/21/2000	0800	0.83	<0.05	0.16	0.15		0.24	0.12	0.81	1.17	0.15	0.11
	0.1	09/11/2000	1008	0.55	<0.05	0.08	0.09		0.04	U	0.50	0.54	0.06	0.01
Average				0.77		0.13	0.11		0.21	0.13	0.60	0.82	0.21	0.05
HC - 2	0.1	07/01/1996	0830	1.65	0.22	0.70	0.37							
	0.1	07/16/1996	0835	2.17	0.16	0.62	0.31							
	0.1	08/19/1996	0825	2.90	0.10	0.80	0.10							
	0.1	09/17/1996	0920	3.50	1.80	6.00	<0.04							
Average				2.56	0.57	2.03	0.26							
HC - 2	0.1	04/22/1997	0938	1.04	0.07	0.15	0.31		0.04	0.21	0.80	1.05	0.08	0.02
	0.1	05/20/1997	0900	1.15	0.05	0.14	<0.04		0.33	0.01	1.00	1.34	0.24	0.04
	0.1	06/24/1997	0835	1.14	0.34	0.12	0.20		0.17	0.05	1.00	1.22	0.15	0.03
	0.1	07/22/1997	0830	1.09	0.15	0.18	0.28		<0.02	0.04	1.00	1.04	0.08	0.04
	0.1	08/19/1997	0800	1.10	0.07	0.09	0.20		0.02	0.18	1.10	1.30	0.18	0.06
	0.1	09/17/1997	0908	0.90	0.08	<0.05	0.11		0.12	0.13	0.90	1.15	0.13	0.05
Average				1.07	0.13	0.14	0.22		0.14	0.10	0.97	1.18	0.14	0.04

Station	Depth M	Date mm/dd/yy	Time hh/mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC - 2	0.1	04/14/1998	0918	0.67	<0.05	<0.05	0.13		0.04	0.02	1.10	1.16	0.08	0.04
	0.1	05/11/1998	0957	0.70	<0.05	0.07	0.11		0.28	0.01	0.60	0.89	0.02	0.02
	0.1	06/12/1998	0833	0.83	0.07	<0.05	0.14		0.58	0.10	1.20	1.88	0.08	0.05
	0.1	07/24/1998	0830	0.68	<0.05	0.07	0.12		0.21	0.03	0.70	0.94	0.21	0.06
	0.1	08/13/1998	1400	0.76	<0.05	<0.05	0.10		0.19	0.15	0.60	0.94	0.20	0.05
	0.1	09/08/1998	1325	0.83	<0.05	0.09	0.11		0.04	0.25	0.40	0.69	0.13	0.10
Average				0.75	0.07	0.08	0.12		0.22	0.09	0.77	1.08	0.12	0.05
HC - 2	0.1	04/30/1999	0900	0.56	<0.05	<0.05	0.08		U	U	0.67	0.67	0.07	0.05
	0.1	05/17/1999	0857	0.53	<0.05	<0.05	0.08		0.29	1.63	0.69	2.61	0.08	0.04
	0.1	06/09/1999	1430	0.81	0.05	0.10	0.12		0.36	U	0.71	1.07	0.04	0.02
	0.1	08/03/1999	1020	1.14	0.06	0.41	0.24		U	0.11	0.48	0.59	0.12	
	0.1	08/23/1999	0910	1.05	0.08	0.28	0.20		0.09	0.07	0.37	0.53	0.08	0.04
	0.1	09/14/1999	0842	1.05	<0.05	0.25	0.18		0.02	0.24	0.77	1.03	0.17	0.06
Average				0.86	0.06	0.26	0.15		0.19	0.51	0.62	1.08	0.09	0.04
HC-2	0.1	05/16/2000	0915	0.64	0.07	<0.05	<0.04		0.03	U	0.66	0.69	0.03	0.02
	0.1	06/20/2000	1415	1.14	<0.05	<0.05	0.11		0.06	U	0.80	0.86	0.08	0.02
	0.1	07/17/2000	0900	0.92	<0.05	0.22	0.16	<0.04	0.44	0.06	0.70	1.20	0.13	0.04
	0.1	08/21/2000	1349	0.79	<0.05	0.14	0.14		0.14	0.14	0.85	1.13	0.13	0.12
	0.1	09/11/2000	0831	0.92	<0.05	0.11	0.18		0.03	0.10	0.80	0.93	0.10	0.07
Average				0.88	0.07	0.16	0.15		0.14	0.10	0.76	0.96	0.09	0.05
HC - 2	18.0	07/01/1996	0848	1.42	0.19	0.29	0.26							
	17.0	07/16/1996	0852	2.26	0.21	0.78	0.45							
	18.0	08/19/1996	0843	1.76	0.12	0.72	0.51							
	19.0	09/17/1996	0939	1.85	0.15	0.60	0.41							
Average				1.82	0.17	0.60	0.41							
HC - 2	19.0	04/22/1997	0947	1.07	0.07	0.16	0.31		0.02	0.10	1.30	1.42	0.04	0.02
	19.0	05/20/1997	0919	1.12	0.05	0.14	0.18		0.49	0.02	1.90	2.41	0.15	0.06
	19.0	06/24/1997	0854	1.09	0.35	0.10	0.18		0.92	0.04	1.80	2.76	0.45	0.20
	19.0	07/22/1997	0849	1.30	0.27	0.27	0.33		1.64	0.03	2.80	4.47	0.65	0.37
	16.0	08/19/1997	0816	1.06	0.12	0.14	0.20		0.11	0.12	1.40	1.63	0.31	0.07
	16.0	09/17/1997	0924	0.99	0.12	0.05	0.25		0.26	0.50	1.50	2.26	0.25	0.08
Average				1.11	0.16	0.14	0.24		0.57	0.14	1.78	2.49	0.31	0.13
HC - 2	19.0	04/14/1998	0937	0.82	<0.05	0.07	0.14		0.10	0.02	1.30	1.42	0.11	0.03
	19.0	05/11/1998	1016	0.73	<0.05	0.09	0.13		0.23	0.01	0.50	0.74	0.01	0.01
	19.0	06/12/1998	0852	0.79	0.08	<0.05	0.15		0.75	0.08	4.80	5.63	0.81	0.08
	9.0	07/24/1998	0839	0.62	<0.05	0.06	0.11		0.77	0.03	1.80	2.60	0.50	0.32
	8.0	08/13/1998	1408	0.81	<0.05	<0.05	0.12		0.50	0.24	2.30	3.04	1.27	0.04
	19.0	09/08/1998	1344	0.82	<0.05	0.07	0.12		0.02	0.22	0.40	0.64	0.13	0.10
Average				0.77	0.08	0.07	0.13		0.40	0.10	1.85	2.35	0.47	0.10

Station	Depth M	Date mm/dd/yy	Time hh/mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC - 2	17.0	04/30/1999	0917						0.13	U	0.57	0.70	0.08	0.07
	17.0	05/17/1999	0914	0.57	<0.05	<0.05	0.07		0.59	1.48	1.29	3.36	0.18	0.05
	19.0	06/09/1999	1449	0.83	0.07	0.12	0.15		0.03	U	0.84	0.87	0.06	0.03
	19.0	08/03/1999	1039	1.10	0.06	0.27	0.17		0.53	0.92	1.06	2.51	1.96	0.14
	19.0	08/23/1999	0929	1.07	0.06	0.34	0.23		0.05	0.30	0.39	0.74	0.10	0.07
	18.0	09/14/1999	0900						0.28	0.16	1.84	2.28	0.53	0.09
Average				0.89	0.06	0.24	0.16		0.27	0.72	1.00	1.74	0.49	0.08
HC-2	19.0	05/16/2000	0934	0.58	<0.05	0.06	<0.04		0.04	U	0.79	0.83	0.07	0.02
	18.0	06/20/2000	1433	1.11	<0.05	<0.05	0.09		0.15	U	2.00	2.15	0.32	0.04
	19.0	07/17/2000	0919	0.90	<0.05	0.19	0.17	<0.04	0.65	0.07	2.22	2.94	0.56	0.07
	15.0	08/21/2000	1404	0.85	<0.05	0.12	0.13		0.54	U	9.00	9.54	3.00	0.10
	15.0	09/11/2000	0846	0.86	<0.05	0.12	0.17		0.10	0.20	0.80	1.10	0.20	0.10
	Average			0.86			0.12	0.14		0.30	0.14	2.96	3.31	0.83
HC-4	0.1	07/01/1996	0900	2.47	0.29	1.09	0.51							
	0.1	07/16/1996	0900	2.16	0.14	0.86	0.43							
	0.1	08/19/1996	0805	1.72	0.11	0.55	0.30							
	0.1	09/17/1996	0855	1.83	0.16	0.50	0.42							
Average				2.05	0.18	0.75	0.42							
HC-4	0.1	04/22/1997	0825											
	0.1	05/20/1997	0945	1.38	0.06	0.22	0.20		0.02	0.01	1.20	1.23	0.02	0.01
	0.1	06/24/1997	0917	1.30	0.41	0.15	0.25		0.16	0.04	0.90	1.10	0.09	0.06
	0.1	07/22/1997	0850	1.43	0.15	0.25	0.28		0.02	0.03	0.90	0.95	0.07	0.06
	0.1	08/19/1997	0820	1.19	0.11	0.15	0.23		0.05	0.02	1.60	1.67	0.32	0.07
	0.1	09/17/1997	0925	1.03	0.07	0.08	0.21		0.13	0.15	0.60	0.88	0.26	0.08
Average				1.27	0.16	0.17	0.23		0.08	0.05	1.04	1.17	0.15	0.06
HC - 4	0.1	04/14/1998	0805	0.69	<0.05	<0.05	0.10		0.04	0.01	1.30	1.35	0.08	0.02
	0.1	05/11/1998	0935										0.00	
	0.1	06/12/1998	0915	0.70	0.06	0.10	0.13		0.17	0.11	1.30	1.58	0.08	0.06
	0.1	07/24/1998	0915	0.69	<0.05	<0.05	0.11		0.10	0.03	0.90	1.03	0.12	0.09
	0.1	08/13/1998	1430	0.80	<0.05	0.09	0.14		0.16	0.02	1.10	1.28	0.27	0.03
	0.1	09/08/1998	1345	0.86	<0.05	0.15	0.14		<0.02	0.21	0.70	0.91	0.15	0.10
Average				0.75	0.06	0.11	0.12		0.12	0.08	1.06	1.03	0.14	0.06
HC - 4	0.1	04/30/1999	1015	0.54	<0.05	<0.05	0.06		0.05	U	0.65	0.70	0.10	0.07
	0.1	05/17/1999	0920	1.00	0.05	0.23	0.13		0.14	1.55	0.94	2.63	0.10	0.04
	0.1	06/09/1999	1450	1.33	0.24	0.37	0.23		0.52	U	0.95	1.47	0.08	0.03
	0.1	08/03/1999	1040						0.04	0.27	0.63	0.94	0.12	0.07
	0.1	08/23/1999	0824	1.03	0.05	0.28	0.18		0.36	0.04	0.40	0.80	0.10	0.07
	0.1	09/14/1999	0900						U	U	1.04	1.04	0.17	0.06
Average				0.98	0.11	0.29	0.15		0.22	0.62	0.77	1.26	0.11	0.06

Station	Depth M	Date mm/dd/yy	Time hh/mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC-4	0.1	05/16/2000	0820	0.53	<0.05	0.18	<0.04		U	U	0.74	0.74	0.06	U
	0.1	06/20/2000	1445	0.69	<0.05	<0.05	0.13		0.06	U	0.86	0.92	0.11	0.03
	0.1	07/17/2000	0945	1.13	<0.05	0.22	0.18	<0.04	0.57	U	1.18	1.75	0.16	0.06
	0.1	08/21/2000	1404	0.93	<0.05	0.14	0.15		0.05	U	1.00	1.05	0.18	0.09
	0.1	09/11/2000	0847	1.00	<0.05	0.13	0.17		U	U	0.90	0.90	0.10	0.06
Average				0.86		0.17	0.16		0.23		0.94	1.07	0.12	0.06
HC - 4	8.0	07/01/1996	0908	2.33	0.35	1.06	0.57							
	4.0	07/16/1996	0904	2.28	2.33	0.85	0.39							
	8.0	08/19/1996	0813	1.78	0.10	0.76	0.48							
	7.0	09/17/1996	0902	1.75	0.11	0.52	0.16							
	Average			2.04	0.72	0.80	0.40							
HC - 4	7.0	04/22/1997	0832	1.09	0.14	0.22	0.35		0.05	0.09	1.10	1.24	0.11	0.01
	7.0	05/20/1997	0952	1.01	0.05	0.14	0.17		0.27	0.01	3.50	3.78	0.55	0.06
	7.0	06/24/1997	0924	1.14	0.27	0.08	0.19		0.31	0.04	1.00	1.35	0.19	0.10
	7.0	07/22/1997	0857	1.15	0.16	0.21	0.29		0.04	0.02	1.30	1.36	0.32	0.12
	5.0	08/19/1997	0825	1.17	0.12	0.14	0.25							
	3.0	09/17/1997	0928						0.23	0.18	1.80	2.21	0.56	0.12
Average				1.11	0.15	0.16	0.25		0.18	0.07	1.74	1.99	0.35	0.08
HC - 4	8.0	04/14/1998	0813	0.73	<0.05	0.06	0.14		0.14	0.03	3.90	4.07	0.62	0.05
	7.0	05/11/1998	0942	0.70	0.18	0.06	0.11		0.38	0.01	0.40	0.79	0.02	0.02
	6.0	06/12/1998	0921	0.65	<0.05	0.12	0.12		0.50	0.08	1.40	1.98	0.25	0.15
	7.0	07/24/1998	0922	0.71	<0.05	0.06	0.12		0.17	0.03	1.30	1.50	0.20	0.09
	7.0	08/13/1998	1437	0.82	<0.05	.05K	0.11		0.27	0.08	2.60	2.95	1.57	0.07
	7.0	09/08/1998	1352	0.79	<0.05	0.09	0.13		0.12	0.22	2.30	2.64	1.03	0.07
	Average			0.73	0.18	0.08	0.12		0.26	0.08	1.98	2.32	0.62	0.08
HC - 4	5.0	04/30/1999	1020						0.05	U	0.77	0.82	0.15	0.07
	7.0	05/17/1999	0927	0.87	<0.05	0.16	0.09		0.23	1.52	1.59	3.34	0.37	0.05
	8.0	06/09/1999	1458	1.29	0.21	0.34	0.23		0.33	U	3.25	3.58	1.36	0.05
	7.0	08/03/1999	1047						U	0.23	0.56	0.79	0.20	0.11
	6.0	08/23/1999	0830	0.97	0.06	0.36	0.17		0.28	U	0.55	0.83	0.74	0.07
	5.0	09/14/1999	0905	0.91	0.07	0.20	0.18		0.06	U	2.31	2.37	0.82	0.16
Average				1.01	0.11	0.27	0.17		0.19	0.88	1.51	1.96	0.61	0.09
HC-4	7.0	05/16/2000	0827	0.64	0.07	<0.05	0.10		0.07	U	0.75	0.82	0.07	0.02
	6.0	06/20/2000	1451	0.86	<0.05	<0.05	<0.04		0.10	U	2.00	2.10	0.63	0.06
	7.0	07/17/2000	0952	1.10	<0.05	0.19	0.16	<0.04	0.51	U	1.26	1.77	0.34	0.07
	3.0	08/21/2000	1407	0.83	<0.05	0.12	0.15		0.02	U	1.00	1.02	0.18	0.11
	3.0	09/11/2000	0850	0.85	<0.05	0.09	0.17		0.20	U	1.00	1.20	0.20	0.09
Average				0.86	0.07	0.13	0.15		0.18		1.20	1.38	0.28	0.07

Station	Depth M	Date mm/dd/yy	Time hh/mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC - 7	0.1	07/01/1996	0930	2.77	0.16	1.40	0.45							
	0.1	07/16/1996	0922	0.90	<0.05	1.10	<0.04							
	0.1	08/19/1996	0750	1.99	0.14	0.43	0.29							
	0.1	09/17/1996	0825	0.86	<0.05	0.07	0.08							
Average				1.63	0.15	0.75	0.27							
HC - 7	0.1	04/22/1997	0900	0.13	0.07	<0.05	0.09		0.13	0.12	1.70	1.95	0.15	0.02
	0.1	05/20/1997	1005	0.47	<0.05	0.17	0.06		0.36	0.12	1.80	2.28	0.21	0.15
	0.1	06/24/1997	0900	1.40	0.31	0.23	<0.04		0.37	0.17	1.50	2.04	0.38	0.29
	0.1	07/22/1997	0911	0.81	0.21	0.28	0.24		0.28	0.13	1.70	2.11	0.45	0.25
	0.1	08/19/1997	0840	1.70	<0.05	0.08	2.30		<0.02	0.15	2.30	2.45	0.35	0.07
	0.1	09/17/1997	0943	1.04	0.06	<0.05	0.16		0.20	0.13	1.60	1.93	0.26	0.10
Average				0.93	0.16	0.19	0.57		0.27	0.14	1.77	2.13	0.30	0.15
HC - 7	0.1	04/14/1998	0830	0.37	<0.05	<0.05	0.06		0.05	0.70	1.30	2.05	0.15	0.08
	0.1	05/11/1998	0900	0.29	0.12	0.12	0.05		0.26	0.22	1.20	1.68	0.12	0.09
	0.1	06/12/1998	0901						0.81	0.43	1.20	2.44	0.27	0.16
	0.1	07/24/1998	0855	0.67	<0.05	0.06	0.13		0.22	0.06	1.00	1.28	0.08	0.06
	0.1	08/13/1998	1500	0.75	<0.05	<0.05	0.13		0.08	0.03	1.00	1.11	0.29	0.06
	0.1	09/08/1998	1415	0.82	<0.05	0.11	0.13		0.02	0.24	0.80	1.06	0.21	0.06
Average				0.58	0.12	0.10	0.10		0.24	0.28	1.08	1.60	0.19	0.09
HC - 7	0.1	04/30/1999	0940	0.40	<0.05	0.12	0.05		0.04	1.64	0.77	2.45	0.23	0.18
	0.1	05/17/1999	0950	2.39	0.24	1.26	0.15		0.29	1.23	1.10	2.62	0.30	0.16
	0.1	06/09/1999	1515	2.57	0.14	1.34	0.47		0.18	0.45	0.99	1.62	0.24	0.15
	0.1	08/03/1999	1108						U	0.07	0.58	0.65	0.24	0.22
	0.1	08/23/1999	0845	0.93	0.07	0.38	0.14		0.13	0.40	0.46	0.99	0.28	0.21
	0.1	09/14/1999	0920		1.25	0.06	0.21	0.16		U	0.18	1.12	1.30	0.28
Average				1.51	0.13	0.66	0.19		0.16	0.66	0.84	1.61	0.26	0.17
HC-7	0.1	05/16/2000	0845	0.36	0.07	0.06	<0.04		U	U	1.00	1.00	0.26	0.10
	0.1	06/20/2000	1500	1.07	<0.05	<0.05	0.13		0.03	U	1.00	1.03	0.35	0.06
	0.1	07/17/2000	0920	1.07	<0.05	0.18	0.17	<0.04	0.60	U	1.94	2.54	0.28	0.05
	0.1	08/21/2000	1425	0.93	<0.05	0.15	0.17		0.05	U	1.00	1.05	0.19	0.06
	0.1	09/11/2000	0903	0.90	<0.05	0.12	0.17		0.02	0.01	0.90	0.93	0.10	0.04
Average				0.87	0.07	0.13	0.16		0.18	0.01	1.17	1.31	0.24	0.06
HC - 7	3.0	07/01/1996	0933	2.52	0.25	1.12	0.40							
	2.0	07/16/1996	0924	3.15	0.15	0.55	0.16							
	3.0	08/19/1996	0753	1.67	0.07	0.37	0.26							
	3.0	09/17/1996	0828	0.91	<0.05	0.07	0.11							
Average				2.06	0.16	0.53	0.23							

Station	Depth M	Date mm/dd/yy	Time hh/mm	Atrazine ug/L	Alachlor ug/L	Metolachlor ug/L	Cyanazine ug/L	Acetochlor ug/L	Ammonia mg/L	NO3/NO2 mg/L	TKN mg/L	TN mg/L	T - Phos mg/L	T - Ortho-P mg/L
HC - 7	2.0	04/22/1997	0902	0.30	0.10	0.10	0.13		0.04	0.20	1.70	1.94	0.17	0.02
	2.0	05/20/1997	1007	0.47	0.08	1.36	0.07		0.52	0.24	2.10	2.86	0.26	0.18
	2.0	06/24/1997	0902	1.56	0.61	0.25	0.31		0.39	0.24	1.60	2.23	0.54	0.44
	2.0	07/22/1997	0913	1.17	0.21	0.28	0.22		0.30	0.03	1.80	2.13	0.28	0.26
	2.0	08/19/1997	0842	0.98	0.14	0.15	0.18		0.15	0.02	2.20	2.37	0.30	0.09
	2.0	09/17/1997	0945						0.33	0.13	1.40	1.86	0.21	0.12
Average				0.90	0.23	0.43	0.18		0.29	0.14	1.80	2.23	0.29	0.19
HC - 7	2.0	04/14/1998	0832						0.06	0.65	1.40	2.11	0.16	0.07
	3.0	05/11/1998	0903	0.26	0.06	0.12	<0.04		0.35	0.35	1.20	1.90	0.17	0.12
	2.0	06/12/1998	0903	1.18	0.14	0.30	0.16		1.14	0.41	1.30	2.85	0.18	0.17
	2.0	07/24/1998	0857	0.69	0.07	0.10	0.14		0.24	0.44	2.20	2.88	0.34	0.16
	2.0	08/13/1998	1502	0.58	<0.05	0.07	0.07		0.19	0.23	2.60	3.02	1.19	0.18
	2.0	09/08/1998	1417	0.91	<0.05	0.05	0.14		0.88	0.22	0.60	1.70	0.17	0.03
Average				0.72	0.09	0.13	0.13		0.48	0.38	1.55	2.41	0.37	0.12
HC - 7	2.0	04/30/1999	0942	0.31	<0.05	0.11	0.05		0.04	1.55	3.30	4.89	1.07	0.21
	1.5	05/17/1999	0952	3.08	0.28	1.89	0.17		0.47	1.42	2.58	4.47	1.08	0.18
	2.0	06/09/1999	1517	2.87	0.19	1.46	0.54		0.25	0.46	1.13	1.84	0.29	0.18
	1.0	08/03/1999	1109	0.66	0.08	0.29	0.15		U	0.74	0.51	1.25	0.24	0.09
	1.5	08/23/1999	0847	0.87	0.07	0.34	0.13		0.18	0.42	0.53	1.13	0.39	0.24
	1.0	09/14/1999	0921	1.28	0.05	0.24	0.15		0.06	0.20	2.67	2.93	0.93	0.13
Average				1.51	0.13	0.72	0.20		0.20	0.80	1.79	2.75	0.67	0.17
HC-7	2.0	05/16/2000	0847	0.31	0.10	<0.05	<0.04		U	U	1.00	1.00	0.27	0.10
	2.0	06/20/2000	1502	1.14	<0.05	0.06	0.08		0.05	U	2.00	2.05	0.30	0.10
	2.0	07/17/2000	0922	1.03	<0.05	0.19	0.17	<0.04	0.60	U	3.86	4.46	1.02	0.07
	1.0	08/21/2000	1426	0.86	<0.05	0.14	0.15		0.13	U	1.00	1.13	0.19	0.06
	1.0	09/11/2000	0904	0.91	<0.05	0.10	0.19		0.04	U	0.80	0.84	0.10	0.04
Average				0.85	0.10	0.12	0.15		0.21		1.73	1.90	0.38	0.07